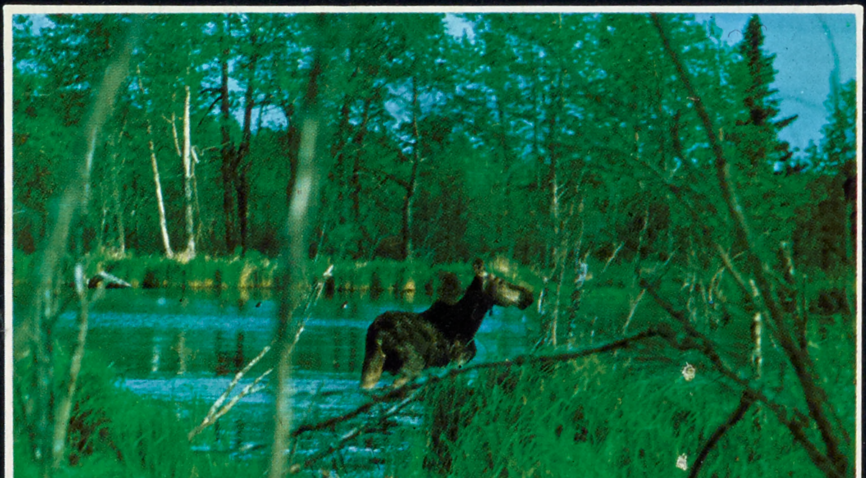

ZOOLOG

On the Cover

Moose photographed by
G. W. Malaher at Beaver Pond
in Riding Mountain National Park,
Manitoba's only National Park.

Zoolog, Volume 12, Issue 1, March 1971
Publication of the Zoological Society of Manitoba and the Natural History Society of Manitoba
Editor — Dieter H. Schwanke
Associate Editor — Peter Press
Free to members of the Zoological Society of Manitoba and members of the Natural History Society of Manitoba
Mailed subscriptions $2.00 per year. Single copy 60c.
Reprints of Articles on request — send all inquiries to:
Zoolog, Clandeboye, Manitoba

Do we need a second National Park?

H. E. WELCH
President
Zoological Society of Manitoba

Two recent events have focussed attention on the question of a second National Park in Manitoba. The first was the illustrated lecture to the Natural History Society on the potential Nahanni River National Park in the North West Territories. The second was the speech to the Selkirk Chamber of Commerce by Ronald P. Malis in which he reported the willingness of the Federal Government to establish a second National Park in Manitoba if and when the provincial government made the land available. There are two potential sites; one near Cranberry Portage in northern Manitoba and the other a 300 square-mile site on the east shore of Lake Winnipeg between the Bloodvein and Berens River.

What is a National Park? It is an area set aside as a national heritage to be preserved unimpaired for the benefit, education and enjoyment of future generations.

Either the Cranberry Portage or the Lake Winnipeg country would be an excellent choice, for both are unusually fine areas of boreal forest on the Canadian Shield. The latter would have the advantage of an excellent stretch of shore-line.

"Yes" is the answer to the question. Riding Mountain National Park provides the reasons. "Riding Mountain" identifies Manitoba as much as "Portage and Main". Its Elk and Bison herds represent wildlife conservation. Its forests, lakes and vistas have attracted countless tourists and most Manitobans. Riding Mountain National Park was established in 1929 when Manitoba's population was just over 600,000. With our present population the need for a second park is critical.

The government's hesitation in providing land may stem from a lack of expressed demand and from the possible loss of potential mineral and forest rights. The former could be rectified by the members of both Societies writing to the government. The latter could be readily determined and if worthwhile, then adjustments probably made in the park boundaries. To set against possible losses are the concrete gains of environmental conservation and of a sound investment for the present and future enjoyment of Canadians.

Delta Diggings

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Past surface collections and limited excavations in the area south of Lake Manitoba indicate that it has been occupied by a variety of cultures since at least 1,000 B.C. With the aim of learning more about these past cultures and their adjustments to the local environment, a field school from the University of Manitoba conducted archaeological reconnaissance and excavation during July, 1969.

The area involved is roughly 15 x 6 miles south of Lake Manitoba. The northern half is covered by Delta Marsh, the remainder is part of the Portage Plain. Relief in the area is slight, allowing marsh water-level fluctuations to inundate or expose large areas. Elevated areas include low ridges adjacent to former drainage channels that flowed into Lake Manitoba from the Assiniboine River. Soils vary from heavy clays of the lake plain to sands of the ridges and modern beaches of Lake Manitoba. Principal vegetation types are deciduous forest on the modern beach ridge, aquatic grasses and sedges of the marsh, and, prior to recent cultivation, prairie with aspen groves on the Portage Plain.

Sites recorded by previous surveys were revisited and collections made from them. Five additional sites were located, and private collections were also noted and photographed. Collections included projectile points, other stone artifacts, stone chipping debris and small amounts of pottery. Among the sites visited were two circular earthworks reportedly built by a band of Dakota Indians when they were escaping from the Ojibwa in the late 19th century. One of these was overgrown with shrubs and could not be precisely located; the other near Clandeboye Bay could be clearly seen.

Another area of interest is the beach adjacent to the University of Manitoba Field Station, which has yielded considerable numbers of points, bison bone and a few pottery sherds, all apparently eroded from deposits underlying the beach.

The site selected for excavation is located on a former beach ridge 400 meters south of the main ridge on the Bell estate, 1½ miles east of the Delta Waterfowl Research Station.

Several 1 x 2 m test trenches were dug adjacent to a road leading from the ridge to the marsh. Most of these produced small amounts of bone

fragments, waste flakes and pottery. Following these tests, efforts were concentrated on the ridge about 50 meters east of the trenches excavated by the Lake Agassiz survey in 1967. A backhoe cleared the shrub cover from an area of about 68 sq. m and a survey grid was established. Pits measuring 1 x 2 m were laid out within the cleared area and dug in 10 cm intervals. At the end of excavation, 28 sq. m had been opened up and a total of 17 cu. m removed.

Cultural material occurred from the surface to a depth of nearly 1 m although it was concentrated in two zones. The upper zone was near the original surface, the second was associated with a dark band, probably a former soil horizon. Materials recovered included mollusk shells, carbonized plant remains, bones, stone artifacts and chips and pottery.

Upon returning to Winnipeg finds were numbered, sorted into categories (bone, shell, etc.) counted and weighed. Artifacts and pottery described, categorized and photographed. Analysis of the materials together with those collected by the Lake Agassiz Survey is still in progress.

Early in the survey it became apparent that the majority of sites were located on the low ridges described above. These apparently served as camping areas and access routes to the lake. Although less valuable during periods of low water, they have been in use since about 1,000 B.C. judging from the point styles found on them.

Because of its locations and relatively undisturbed condition, the Bell site provides a key to the late prehistoric occupation of the area. Pottery and projectile points are typical of the Late Woodland period (ca. 1000-1700 A.D.). The pottery includes types from the Laurel, Lockport, Manitoba and Winnipeg River wares defined by MacNeish (1958) for Southeastern Manitoba. The site may have been intermittantly occupied during much of Late Woodland times but more precise dating must await C-14 analysis. Stone artifacts included points, scrapers, knives and utilized flakes, most of them manufactured from locally-obtained chert. A few were of a non-local brown chalcedony (Knife River Flint).

Historic Indian groups in the region were primarily buffalo hunters although other items were part of their diet.

Although evidence is as yet scanty, the environment of the area appears to have been more or less uniform for the past 1,000 years. Lake water levels probably fluctuated about as much as they have in recent decades, alternately flooding and exposing large areas of the marsh. Bison would be available on the ridges and margins of the marsh during the spring and summer but may have sought shelter in aspen groves to the south in winter. Beaver and muskrat could be captured during all seasons, birds would be especially numerous during spring and fall migration and fish could be most easily obtained during spring spawning.

The Late Woodland inhabitants of the area were seasonally nomadic, gathering in larger groups when there was abundant food, splitting into smaller groups when food was scarce. The Bell site seems ideally situated for such groups to gather and exploit the resources of both the marsh and the lake. It was probably occupied during two seasons of the year; late summer or early fall for hunting and plant collecting and spring for hunting and fishing. Other camps on the ridges leading to the marsh would also have been occupied during the warm months of the year. The people spent the winter in the shelter of aspen groves.

Although it can be inferred that the site was occupied by family groups there is little to indicate the kinship composition or residence rules of these groups. One clue to such social patterns is the variable and often distinctive designs applied to pottery vessels before they are fired. It is safe to assume that women were the potters in Late Woodland times as they were among historic Canadian Indians. These designs together with their techniques of application would be passed on from mother to daughter (or grandmother to granddaughter) much as sewing skills are today. If women moved from their natal group at marriage, pottery decoration would be thereby dispersed, with women from different groups each making the styles learned in their original group. If, on the other hand, men joined their wife's group at marriage, decoration would be less variable. Decorative variation within sites compared to that between sites should thus reflect post-marital residence and the degree of wife/husband exchange between groups.

The Bell site pottery is quite variable, representing types from four different ceramic wares. Several types appear to have been deposited at the same time, possibly by the same group. Corresponding ceramic variety involving the same pottery types occurs in upper levels of several southeastern Manitoba sites (MacNeish 1958). If this variety was produced by single groups, then within-site variation is greater than between-site variation suggesting that female potters left their groups at marriage. Furthermore, the distribution of some pottery types over much of Manitoba indicates a wide network of social interchange. Another indication of intergroup contacts is the occurrence of Knife River Flint at the Bell site and elsewhere in southern Manitoba (Leonoff 1970). This material is derived from deposits in central North Dakota although some can also be found in river gravels near Souris, Manitoba. Trade with the south was probably the means used to obtain it.

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Roaring River Relic

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A Bison skull, currently the property of Mr. F. A. Twilley of Swan River, was recovered several years ago from the bed of the Roaring River in the Swan River Valley of Manitoba. The precise location of the find was pointed out to me by the landowner, Mr. R. Klein, who was present when the discovery was made. Since it was extracted directly from the *bed* of the stream rather than from an adjacent bank, there was no opportunity to observe its original, unmodified geological context. The dimensions and morphology, together with its general weight and condition, strongly suggest that it belonged to a member of a now-extinct species.

Despite the fact that the specimen was removed from the riverbed, it does not appear to have been carried any great distance by stream action, as the horn cores are very well preserved. In the event that it *was* derived from upstream, its place of origin must have been fairly local nonetheless, since the headwaters of the Roaring River and its tributaries are in nearby Duck Mountain.

All horn core dimensions of the specimen exceed the maximum figures for both *Bison bison bison* and *Bison bison athabascae* (Skinner and Kaisen, 1947). This factor, along with the weight and mineralized condition of the bone, argues strongly for the conclusion that the specimen represents one of the extinct forms. For several reasons, however, the skull cannot be speciated with certainty. Skinner and Kaisen (1947) obviously feel that age and sex are essential considerations in the identification of fossil forms (all of their measurements relate to *adult males).* The main criteria used for determining age are tooth wear and the number of rings on the horn sheaths. Since the present specimen lacks *both* teeth and sheaths, one is hard put to determine its age. Nor can it be sexed due to a lack of comparative data.

Quite recently, Dr. John Elson (1962:8) has reported Bison bone occurring in alluvial fill in small gullies tributary to the Assiniboine River near Treesbank, Manitoba. Alleged remains of *Bison occidentalis* were found in the same district during the years 1914 to 1916 and brought to the attention of O. P. Hay (1924:200). Additional Bison re-

mains, also thought to be occidentalis, were discovered near Douglas, Manitoba (Hay, 1924:200). At Arden, somewhat to the north of the Assiniboine delta where the above finds were made, the bones of an unidentified species of Bison were taken from the base of the Upper Campbell beach at a depth of 30 feet from the surface (Hay, 1924:200).

Extinct Bison remains are rather uncommon not only in the Swan Valley, but in Manitoba as a whole. This is understandable, since most of the province was flooded by Glacial Lake Agassiz when the now-extinct mammals occupied the northern Plains after the close of the Pleistocene (Forbis, 1956). Modern Bison remains, however, are well represented in the Swan River area. According to Hill (1965:4), "it may be noted that swamps immediately below the lower Campbell ridge . . . have yielded many modern Bison remains . . ."

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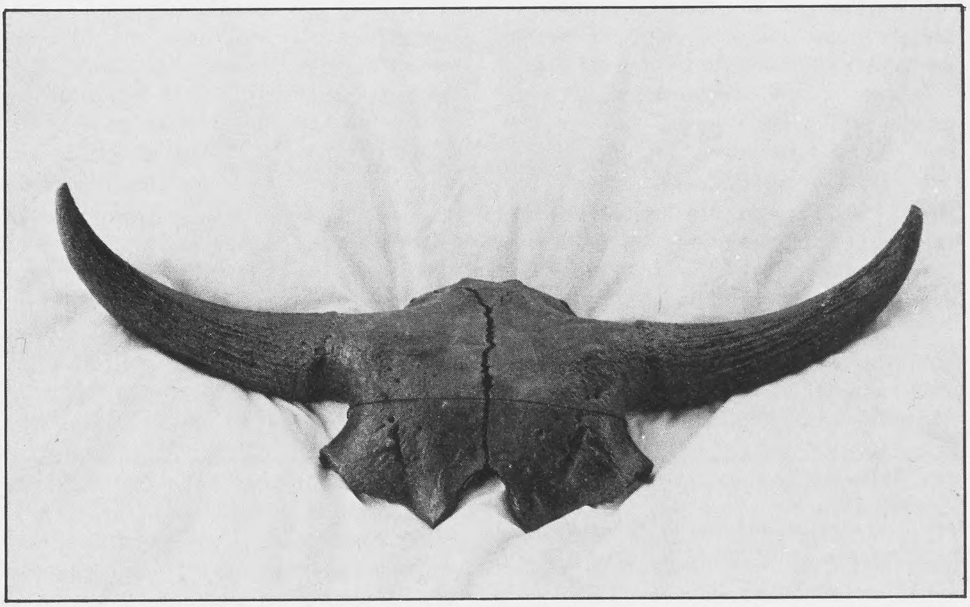
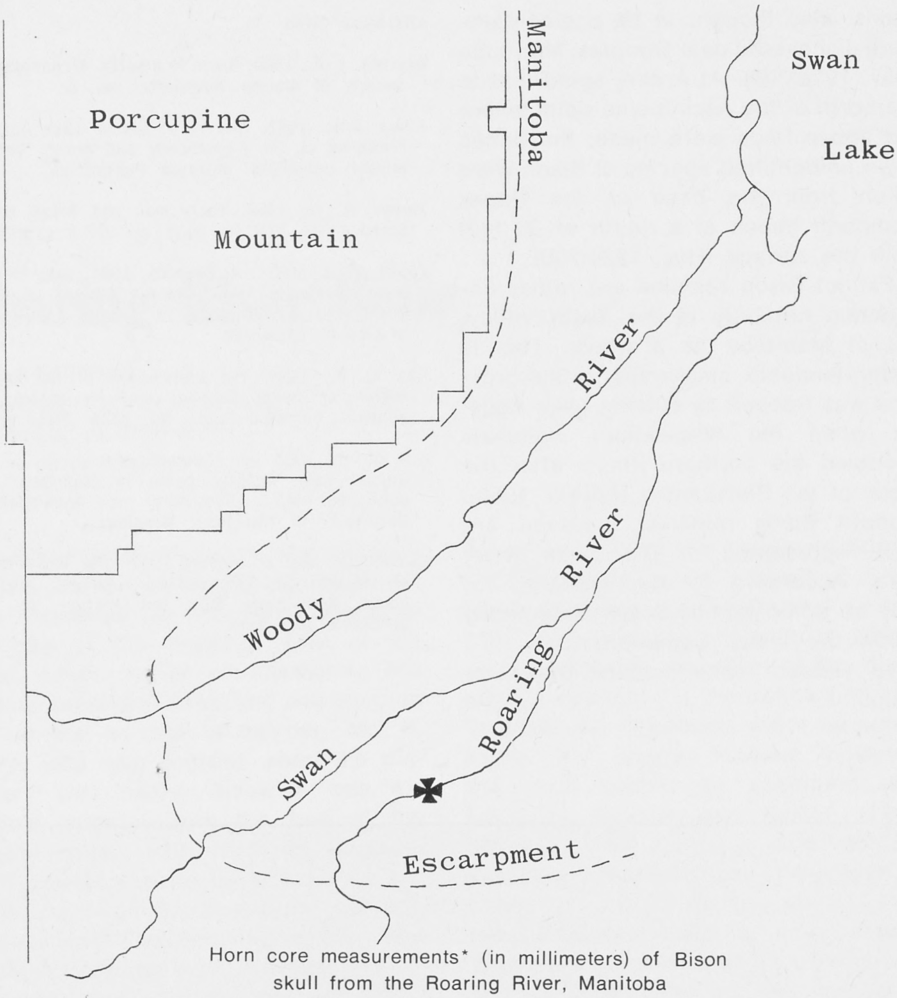




Horn core measurements* (in millimeters) of Bison skull from the Roaring River, Manitoba

Spread of horn cores, tip to tip	900
Greatest spread of cores on outside curve	915
Core length on upper curve, tip to burr	350
Core length on lower curve, tip to burr	400
Length, tip of core to upper base at burr	320
Vert. Diam. of core, 90° to longitudinal axis	97
Circum. of core, 90° to longitudinal axis	289

*Measurement categories after Skinner and Kaisen (1947)

General plan of the Swan River Valley, showing the location of the bison skull (cross).

The most difficult deer

CLIVE ROOTS

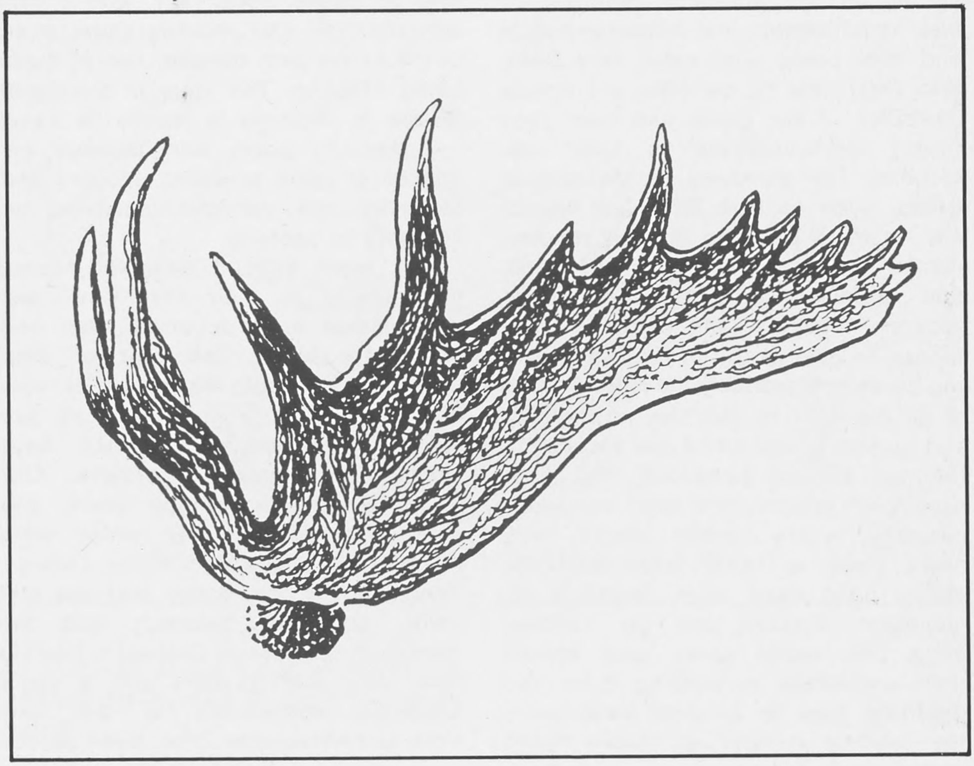
It is common policy in zoological gardens to group members of the deer family into two types — the browsers and the grazers. The grazers are by far the easiest to maintain as their requirements are relatively simple and they breed with ease. Red Deer, Sika Deer, and Fallow Deer are typical examples of this group and most zoos have representatives in their collections. The members of the second group, such as Roe Deer and Moose are far more exacting in their requirements, are less frequently exhibited, and certainly could not be termed regular breeders in captivity. The Moose (known as Elk in English speaking Europe) is probably the most difficult of all the deer to maintain in captivity and records of live births and successful rearings are not numerous. The most successful results have been achieved, naturally, where captive Moose have been given a fairly large paddock and a good sized pool. Shade is an important requisite and the addition of a fine water spray also assists their well-being by cooling them and deterring flies. In the past three years the average number of Moose births annually in the world's zoos has only been six, most of these occurring in North America. Milwaukee Zoo has the finest record, having produced over 30 calves since 1951, with a high survival rate. Our records show three births in the past decade, two of these being stillborn. The story of European Moose in captivity is much the same — generally poor, with isolated examples of good breeding success and longevity, one individual surviving for 15 years in captivity.

The most difficult time for Moose in captivity is their first year, and most losses have occurred here, and elsewhere, within the year of their birth. Calves begin eating solids very early in life and once weaned are usually little trouble if they have access to plenty of browse. Our longevity records of ten years and nine years for the pair which were shipped to Champaign Parks District, Illinois in the fall, where they are still living, compares favorably with the record of 12 years at Chicago's Lincoln Park Zoo, and 9 years and 8 years achieved respectively in the New York and Milwaukee Zoos. Even so, the

average captive life span has not been as extensive as the natural span of 20 years or so would indicate.

Parasitic infections, overgrown hooves and digestive upsets if their diet is changed very slightly from the norm, and particularly if they receive their large concentrate ration in one feed, are the main problems facing captive Moose. Overgrown hooves occur when animals are housed on a 'natural' area — grassy, and in parts muddy, paddock with a pool, and little in the way of hard abrasive surfaces, which are a feature of many areas in their native habitat. Assuming that their physical well-being is provided in the shape of suitable floor conditions, shelter and water, Moose problems appear to be almost certainly related to diet, resulting in poor breeding success, a high number of stillborn calves and a fairly high loss rate soon after birth. The standard Moose diet is a bulk ration of good quality alfalfa or clover, a quantity of manufactured concentrates of the dairy pellets type, and fruit and vegetables. Apples, carrots, bananas, mangolds; beetroot, kale and sugar beet usually figure in their rations.

Feeding the correct type of concentrate to any herbivore is a relatively simple matter if the animal's requirements and natural foods are known, but seasonal variation of food to correspond with natural variations is a more complicated subject. Take

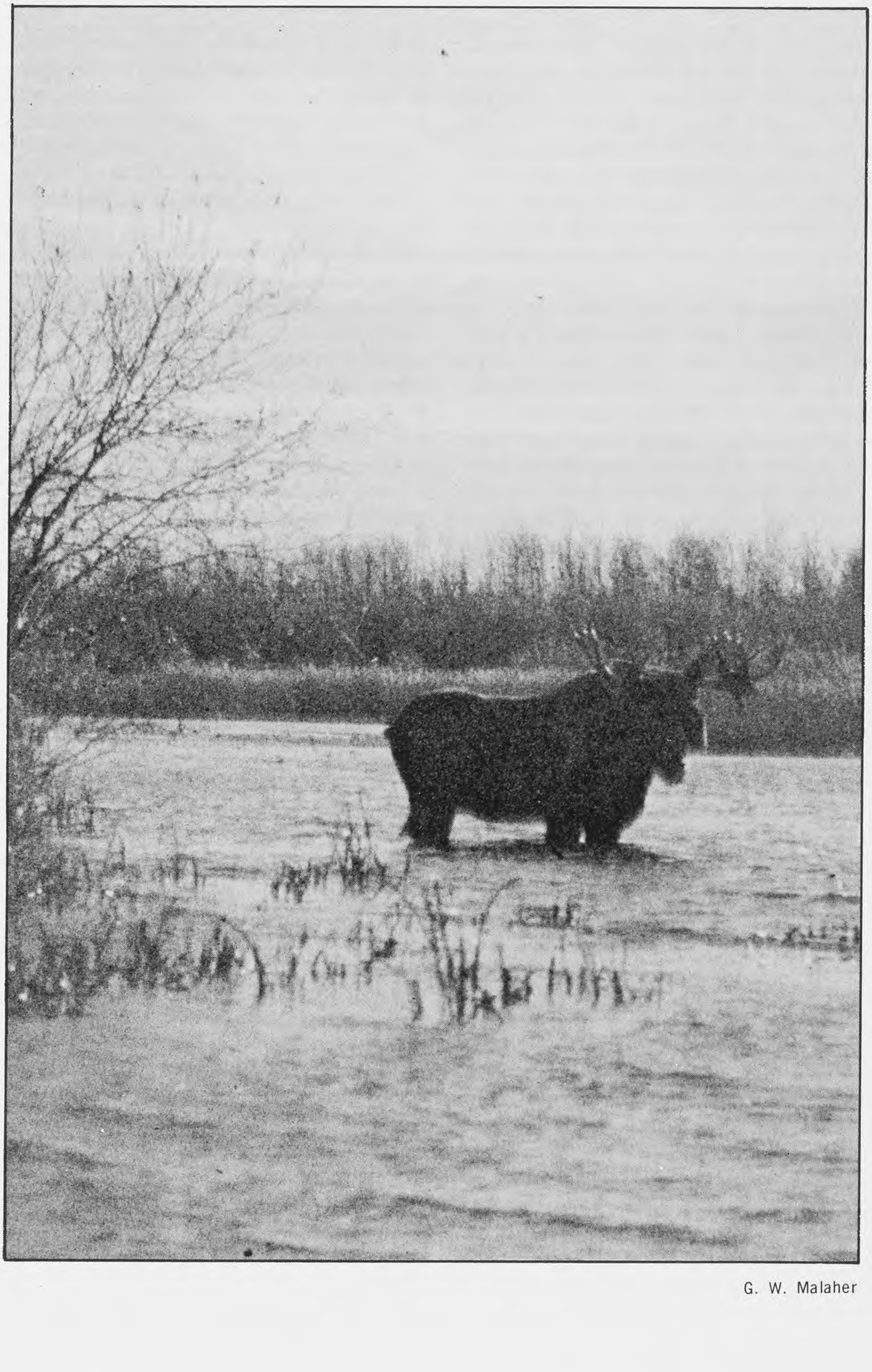


the case of the annual rut, when in the natural state it has been estimated that Moose bulls lose upwards of 150 lbs. when they are very active, travelling more and eating less, than at any other time of the year. The lack of similar physical strain and loss of weight of a captive bull, fed like a Hereford steer during the summer to simulate natural conditions possibly affects fertility. The lack of competition and stimulation for the captive bull with one cow — how unnatural anyway for basically solitary animals — must also have some effect. The strain placed upon wild bulls by the production of their solid bone antlers during the summer months must be counteracted by additional feeding, producing an animal in its prime by the time of the rut. In captivity the increased food provided during the spring and summer in the form of concentrates rich in protein and the vitamins and mineral salts needed to grow the massive antlers, produce an animal which reaches its prime in the fall but does not have the opportunity to lose his surplus weight.

Additional minerals are certainly necessary. Franz Vogt, a German chemist, once calculated that a Red Deer stag needed two ounces of minerals daily to produce antlers eventually weighing 22 lbs. In comparison a good set of Moose antlers could weigh twice as much, being produced in a period of four months, at the rate of about 10 lbs. per month — truly a phenomenal feat, repeated annually.

Similar problems of seasonal feeding exist where cows are concerned. They need to be well nourished during the spring and early summer if they are to produce healthy calves and rear them, but unless the condition of captive mature cows is carefully checked to ascertain as soon as possible in the spring if they are in calf, the continued good feeding well into summer may produce an obese animal incapable of breeding in the fall.

Like most fairly difficult zoo animals the challenge to improve longevity and breeding success has resulted in a high demand for young Moose. In the past five years, the Assiniboine Park Zoo has shipped young specimens to Rotterdam, Paris and Baltimore, and just this February three fine specimens went by air to Tokyo. For reasons of size, handling and shipping costs, there is little demand for adults. At birth the spindly legged babies weigh thirty pounds, and the three animals shipped to Tokyo recently weighed approximately 380 lbs., showing a weight gain of 350 lbs. in eight months or 44 lbs. per month. They were bottle reared in the Children's Zoo and their rapid growth rate must be attributed to the fact that they had liberal supply of browse from the time they were weaned. Browse is considered so important by some zoos that they have placed a winter supply in cold storage. Another interesting aspect of Moose husbandry is that there are apparently no documented cases of successful mating by 16 month old bulls in the rutting season of the year following their birth, no doubt due to the competition of older, heavier bulls. There are instances on record, however, of successful breedings by older bulls of females in their second year. Our youngest pair, born in 1969, were observed mating in the fall of last year, so we may have an opportunity yet of adding to the wealth of knowledge already documented on the largest member of the deer family.



G. W. Malaher

"Equal to the elephant itself"

G. W. MALAHER

The Moose — the largest living deer — is in his natural environment an impressive animal. If we can believe the ancients, the Moose was at one time a truly remarkable animal described variously as:

"A goodly creature, twelve feet high, with exceeding fair horns that have broad palms, two fathoms (12 feet) from the top of one horn to another. . . . It is a creature, or rather a monster of superfluity, and many times bigger than the English Ox."

Or again as — "equal to the elephant itself."

It was also at one time believed to be subject to epilepsy and to cure itself by scratching its left ear with its left hind foot until it bled. One authority even claimed that it scratched its left ear with its right hind foot. If it could do this while in an epileptic convulsion it must have possessed acrobatic skill of a high order! There are many other quaint tales and mythical legends regarding the Moose.

The Moose has a number of sub-species, there being four recognized on this continent alone. Some of us feel that to separate the forms of Moose merely by measurement of the jaw or slight difference in size or colour of the animal is drawing a pretty fine distinction. Should we apply the same principle to the human race the number of sub-species would be legion. Even brothers might find themselves separated by the stigma of separate sub-species.

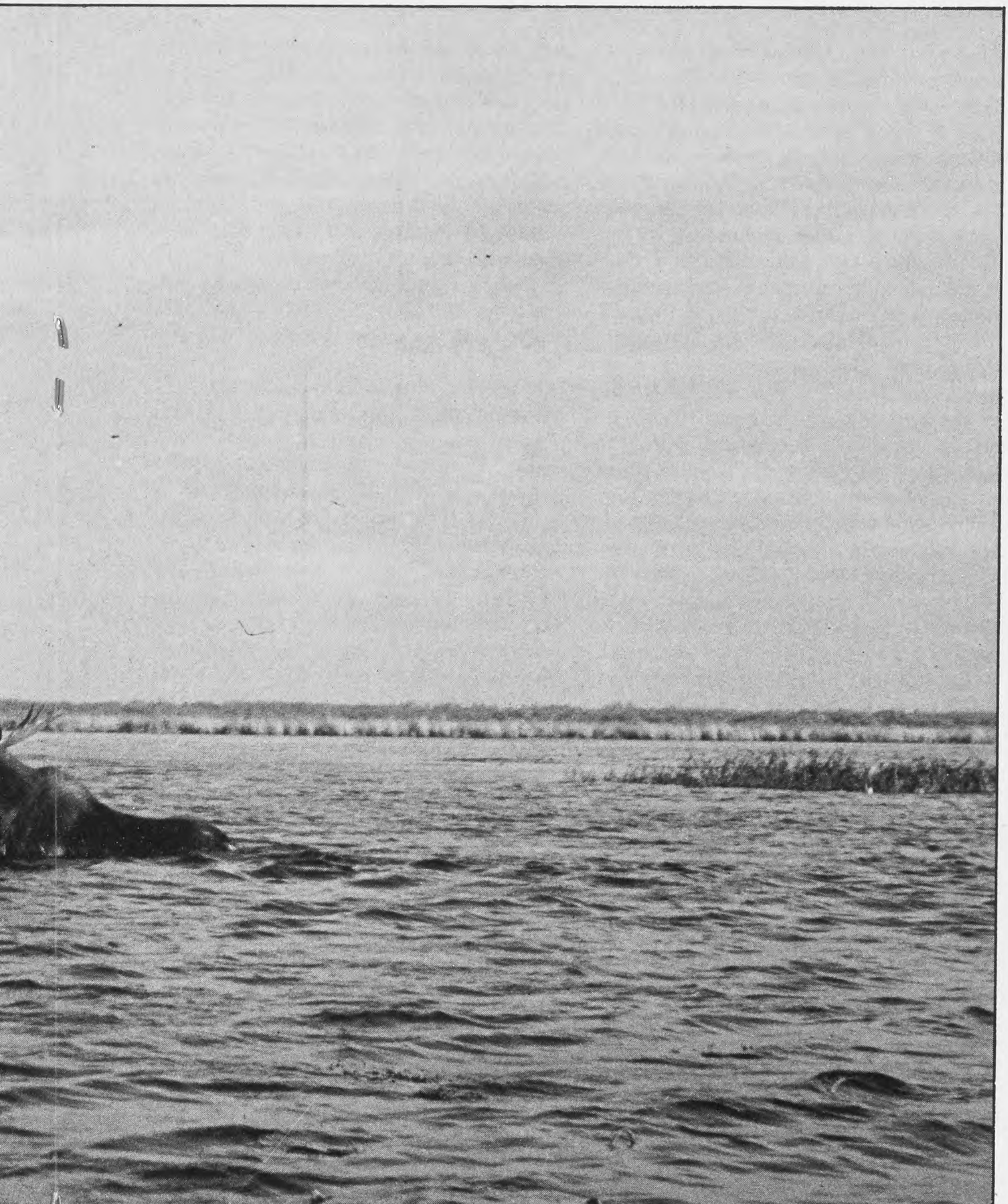
The range of the Moose on this continent does not appear to have changed nearly as much as some other species such as the White-tailed Deer. It is now extinct in Pennsylvania and New York, the southern extremity of its primitive range; but has on the other hand extended its range northward across the continent. In 1924 when at the north end of Reindeer Lake I learned from the Indians that Moose had only appeared there some ten years earlier. Today it may be found much farther north.

In 1900 Mr. G. H. Measham writing to Ernest Thompson Seton from Shoal Lake in the Interlake area said:

"I can safely state that within 50 miles of Winnipeg there are hundreds of Moose; and that within 100 miles there are thousands of them."

Seton estimated the Interlake (500

G. W. Malaher



square miles) Moose population at roughly 2 per square mile.

In recent years it was feared here and elsewhere that the Moose would disappear entirely but more recently with more information gathered by research and with a better measure of protection, it appears that the Moose is more than holding its own.

In some areas such as parts of British Columbia it is today unquestionably more abundant than in primitive times. The reason for this probably lies in man's exploitation of the forest, and the creation of better habitat in areas of second growth where logging or fires have occurred. Strange as it may seem, a mature, evenly aged and dense stand of timber is perhaps the nearest approach we have to a biological desert.

One of the best Moose populations in Manitoba today has resulted from its protection on the Summerberry Fur Rehabilitation Block in the delta of the Saskatchewan River. One normally thinks of this as a Muskrat area but there are large tracts of willow and other brush and timbered stream banks which provide both food and cover. During summer months there is an abundance of water lilies and other aquatic vegetation which the Moose enjoys.

For an animal of its size the Moose can move with amazing quietness, making far less noise than a man. When frightened, however, it will go crashing through the bush with more noise than a train load of hunters.

It is not easily frightened or rather will not take headlong flight without first ascertaining the cause of disturbance. On scenting man, however, it can disappear almost miraculously and without a sound.

Deer will leap into immediate flight with no apparent thought of direction but the Moose will stand, find the cause of disturbance and then move off with deliberate intent of avoiding danger. This momentary hesitation would involve no hazard but for the rifle in the hunter's hands. If the Moose cannot fathom the mysteries of firearms he is at least no worse off than those sportsmen who, similarly deficient, are responsible for the shooting accidents of the hunting season.

The natural range of the individual Moose is small, perhaps not more than ten square miles under normal circumstances. At the time of the rut, however, "home range" may be entirely disregarded.

There is a good deal of difference in opinion as to the mating habit of the Moose, some affirming that it is monogamous, others that it is polygamous. Perhaps a "limited type of polygamy" would be the best description, for it does appear that more than one mating will take place in the season.

Females normally mate at 2½ years but may occasionally mate successfully at 1½. It is quite possible that such early matings are related to the quality and quantity of food available in the particular area.

The immature male, though perhaps capable of mating, does not frequently get the opportunity — the older and stronger bulls maintaining that right by might.

Calves at birth apparently weigh from 10-30 lbs. and though helpless for a day or two grow very rapidly. Twins are sometimes produced and rarely triplets. The calf or calves stay with the mother until the time the next calf is born; indeed both the new calf and the yearling have been seen together with the mother.

Normally the Moose is a very docile animal. If he thinks he has a chance to get away he will almost always take

it but because he wishes to assess the danger by sight, smell and hearing before taking off, he is sometimes thought to be contemplating attack.

During the rutting season, however, it is well to leave the bull Moose alone.

I well remember an incident when canoeing along the shoreline of a large island in the Summerberry marshes. It was during the rutting season and we heard two bulls fighting, not far back in the island. I went quietly ashore with my camera hoping to get a picture but the animals must have got wind of me as they separated and disappeared.

Returning to the canoe I told the conservation officer who was with me of the disappointment and we continued paddling towards the point of the island some half mile distant. We had not gone far when a thrashing and grunting in the woods attracted our attention. It was one of the two bull Moose I had tried to photograph and by his behaviour, I judged he had had the worst of it. He was very angry, striding through the timber and thrashing his antlers against the trees, first on one side, then the other. Each swinging motion of the head was accompanied by a deep grunt.

Out came the camera again but there was too much underbrush for a good photo. We followed noiselessly in the canoe until the Moose entered the water at the end of the island and stood belly deep, cooling off his temper. To get a picture we pushed out past the point but even the sun was right behind the Moose. "Paddle round him and get closer", I whispered. At this point the Moose saw us. Up went his head, back over his shoulders stretched his antlers and with bulbous nose outstretched and long "bell" hanging below he plunged through the water towards us. I believe he thought we were his old antagonist. To my dismay the conservation officer sheared away with the canoe and again a good picture was lost.

A moment later the Moose got wind of us, changed direction and swam out across the lake. He was going upwind and we paddled hard to catch up with him but the two of us could only keep pace with him; hardly gaining at all. One more picture and he had gained too much to be followed further.

Though we do not have thousands of Moose within 100 miles of Winnipeg today as declared some fifty years ago, we do still have Moose in some numbers in southern Manitoba. They are to be found in the Whiteshell and Bird River areas and northward on the east side of Lake Winnipeg; are still common in the northern portion of the Interlake area; occur in some numbers in the Riding Mountain, and there is also a small herd in the Spruce Woods Preserve almost within sight of Brandon. Several years ago an old cow Moose fed so nonchalantly in the Douglas swamp that she stopped all the traffic on No. 1 Highway.

We cannot expect the Moose to thrive close to agriculture except in special areas like the Spruce Woods and Riding Mountain, but we can expect that with even reasonable care we can maintain a good population of Moose in the vast undeveloped forest areas of our province.

The Sting

Do bees working for honey
  Early and late,
As we do for money,
  Complain of their fate,
'Trouble deaf Heaven', and fiercely
  swear,
How much, Oh, Lord, can a bug bear?

LAURA E. BALDWIN

Infrared Receptors in Snakes

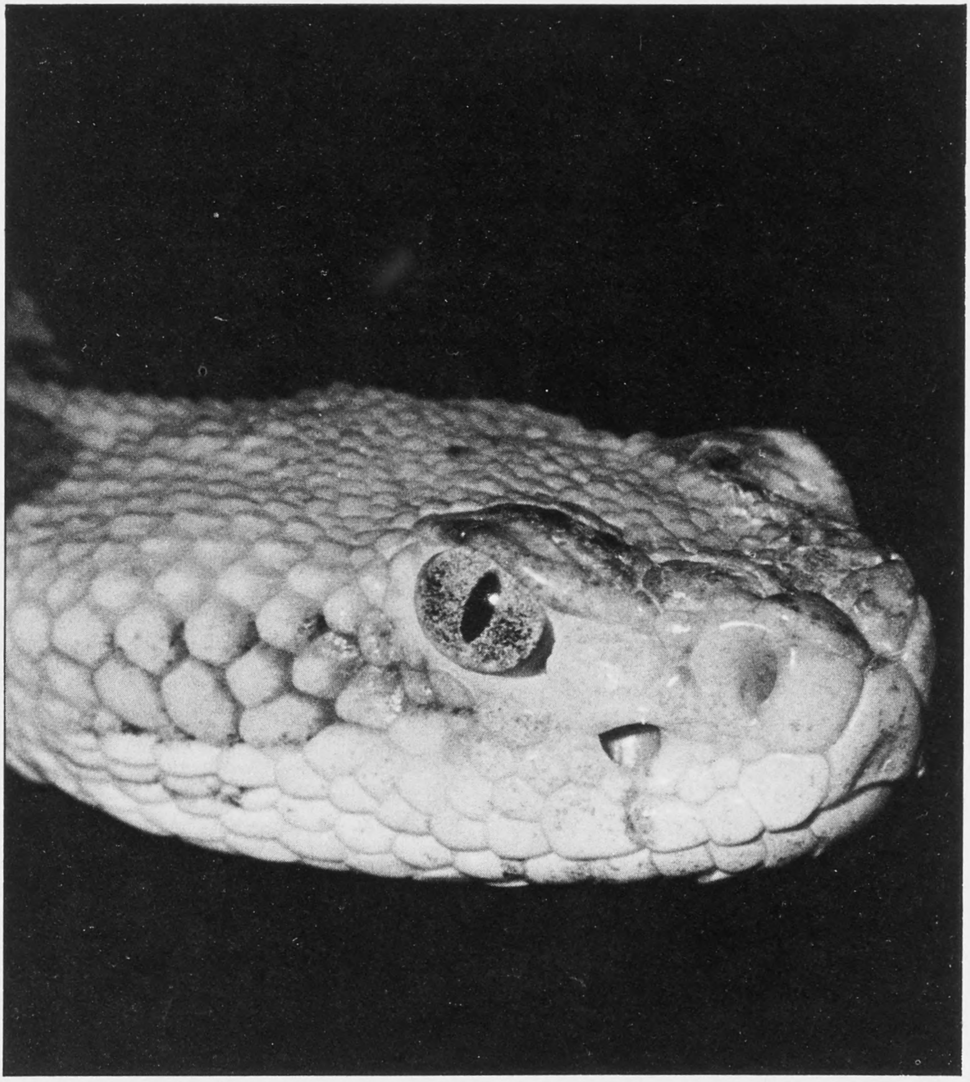
WILLIAM B. PRESTON
Manitoba Museum of Man and Nature

Animals, to maintain contact with their environment, must depend upon various sensory receptors adapted for the reception of particular environmental stimuli. One such stimulus is infrared radiation. Special organs for the reception of infrared radiation, or heat, are known in two families of snakes, Viperidae (vipers) and Boidae (pythons and boas). Perhaps a brief comment on the classification of these families is justifiable at this point. Viperids are commonly grouped into two subfamilies, Viperinae (true vipers) and Crotalinae (pit vipers). True vipers are restricted to Africa, Europe and Asia, whereas pit vipers occur in North and South America, southeastern Europe, and Asia. Pit vipers are represented in Canada by three species of rattlesnake, the Northern Pacific Rattlesnake *(Crotalus viridis oreganus)* of British Columbia, the Prairie Rattlesnake *(Crotalus viridis viridis)* of Alberta and Saskatchewan, the Timber Rattlesnake *(Crotalus horridus)* and the Eastern Massasauga *(Sistrurus catenatus),* both of Ontario. The Timber Rattlesnake probably no longer exists in Ontario.

Pit vipers are named for the facial pit, located between the eye and the nostril. The two pits are directed forward, much like the headlights of an automobile, with a groove extending from the opening of each pit to the eyes. Two separate chambers, both of which open to the outside, make up this rather complex organ. The opening of the outer chamber is large and readily visible, while that of the inner chamber is small and generally closed. The pit membrane separates the two chambers. In the skull, allowance is made for the organ by a deep pit in the maxillary bone, the bone which bears the fangs. True vipers lack this pit.

The facial pit is supplied by branches of the trigeminal, or fifth cranial nerve. Lynn (1931) pointed out that "In snakes having no pits, the trigeminus supplies the skin of the face and the roof of the mouth together with certain of the muscles . . . . In the pit vipers, on the other hand, by far the major portion of the ophthalmic and supramaxillary branches of the trigeminal goes to supply the pit, furnishing this organ with a nerve supply which is comparable in amount to that of any

of the sense organs of the head." Bullock and Fox (1957) described the nerve endings as palmate in structure, having no connection with any type of sensory cell. These nerve endings are located in the pit membrane.



W. B. Preston, February 1971

In this view of a Timber Rattlesnake (Crotalus horridus) *the pit membrane is visible.*

It was the work of Noble and Schmidt (1937) that revealed the nature of the pit organs. They found that pit vipers deprived of the sense of sight and smell could distinguish between warm and cold light bulbs and also between a warm, freshly killed rat and a chilled rat. More recent investigations (Bullock and Cowles, 1952; Bullock and Faulstick, 1953; Bullock and Diecke, 1956) revealed that the nerve fibres supplying the pit are spontaneously active. Increase in temperature of the pit membrane resulted in an increase in the rate of neuronal discharge while a decrease resulted in a decrease in the rate of discharge. Bullock and Diecke have hypothesized that the receptors are responding to temperature changes in the tissue resulting from radiant energy, these temperature changes being enhanced by the thin membrane. By running water over the pit membrane and recording nervous impulses these workers found that a temperature difference of 0.003 to 0.005 degrees C would elicit a response in the nerve.

Based on developmental and anatomical evidence, Noble and Schmidt suggested that the facial pit of pit vipers evolved through fusion of two pits of the boid type. These two families, Viperidae and Boidae, however, appear to be distantly related, so that the similarity in form and the functional analogy of the receptors is due entirely to convergence.

What significance in the life of the snake have these specialized organs that appear to have evolved independently in at least two groups of snakes? Both groups, the boids and the viperids, are primarily nocturnal in habit. Also, both groups feed primarily upon endothermic, or "warm-blooded" prey. Although the eyes of pit vipers and boids have vertical, elliptical pupils, as do those of most nocturnal snakes, and are probably more efficient in darkness than are those of diurnal species, good vision is not among the attributes of snakes. The sense of smell however, is highly developed and is no doubt of great importance in locating prey. When the moment of truth arrives, that is, when the snake is about to strike or seize the prey, a sensory organ capable of assistance in locating the prey animal is of a distinct advantage. Such an organ is the infrared receptor. Noble and Schmidt concluded that "in the absence of vision the labial pits of Boidae and the facial pits of Crotalidae are the most important sensory mechanisms for directing the strike towards warm-blooded prey." The true vipers are also mainly nocturnal, and it has been suggested that they too may have infrared receptors. To date, however, none have been demonstrated.

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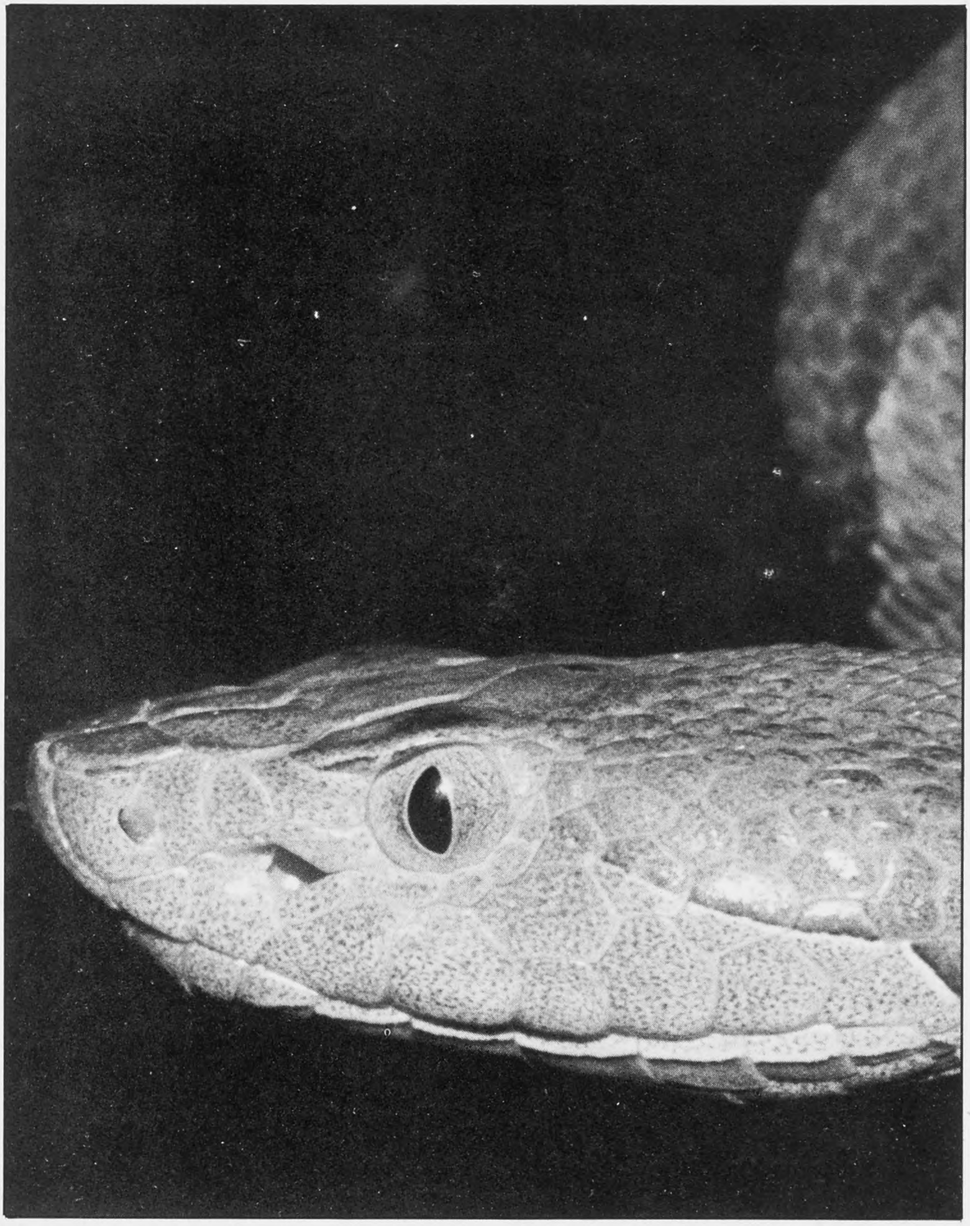
The Copperhead (Agkistrodon contortrix) *is a pit viper occurring in the eastern United States. The pit is located between and slightly below the eye and the nostril.*

W. B. Preston, February 1971



I Like Lichens

F. PAUL RALSTON, JR.
Curator of Botany
Manitoba Museum of Man and Nature

No other kind of living thing comes readily to mind which is actually a composite organism and is so definitely two organisms living together. Consider the separate components of lichens: algae (usually green algae) and fungi. Both distinctive in their characteristics: the algae cells appearing to be quite usual for their species, and the fungus component showing the filaments so typical of fungi. Indeed the algae of lichens is for all practical purposes the same as others of these species which can be found growing free in ponds and streams. However, this cannot be said for the fungus component, because these particular fungi are never found growing alone. A most interesting experiment is to actually separately culture the two component organisms artificially in a test tube. The algae seem to thrive perfectly normally, and to carry on their functions of growth and reproduction. But this is not equally true of the fungi of lichens, for when they are cultured alone they do not grow nor reproduce to any extent. If, however, one of the strands of the fungus comes in contact with an algal cell, this strand grows to surround the algae and can then develop into the typical lichen. If one looks at the inside of a lichen through the microscope, its dual nature is clearly shown. The scattered separate dark cells are the algae, surrounded by the fungus strands. Examined closely, each agal cell is seen to have "suckers" attached to it from the strands. The technical term for the structures, wherein fungi extract nourishment from cells of other plants is haustoria. Thus the fungi of lichens are shown to be parasites and the algae are the hosts. In some host-parasite relationships, for instance wheat rust or a tapeworm, the host is clearly seriously victimized and would be immensely better off if it weren't thus afflicted with the parasite. But in the lichen relationship between fungi and algae, the relationship is not as black and white as a typical case of parasitism. The algae apparently thrive inside a lichen, the most successful lichen reproduction being a breaking off of small powdery pieces containing both fungal and algal cells which blow around and then can grow into the mature lichen.

In botany textbooks lichens are usually put into subgroups on the basis of their shape. As with many other groups of organisms, lichens are a varied assemblage lumped together for study purposes, and the three main shapes are not really absolutes. Consider for instance classifying people on the basis of: thin, medium, and fat. There would still be numerous people who'd be intermediate between these rigid categories, and so it is with lichen shapes. They intergrade from the simplest shape a coat-of-paint structure so thin that it's next to invisible on a boulder (crustose) to a scale-like or leafy shape (foliose) and up to what appear to be masses of hair or small erect gray "trees" (fruticose). Some lichens grow out sideways as their flat clumps expand slowly year after year, others grow into greater complexity as their "branches" and scales repeatedly rebranch and elongate.

In earlier times, when civilizations obtained more of their materials directly from nature, lichens were a very important source of chemicals, and to a lesser extent of food. Dyes were nearly all of biological origin at one time, and lichen dyes were among the best in color fastness. One did not just gather lichens and have the dyes flow out however; so much specialized treatment was needed that it's difficult to imagine how they were originally discovered to be a dye source. Take the brown dyes of Harris tweed. A particular lichen of the Western Scottish islands is gathered, finely ground, and put in urine for weeks or months. As the urine putrifies to form more ammonia the lichen dye is slowly extracted, and made into a paste, orchil, which is wrapped in leaves and smoked to prepare it for storing. The tweed is put in the dye solution for several days and then if it has been successful, the dye will not wash out. Other peoples in time and place have used lichen dyes, thus showing that native appreciation of the possibilities of these plant products is very widespread.

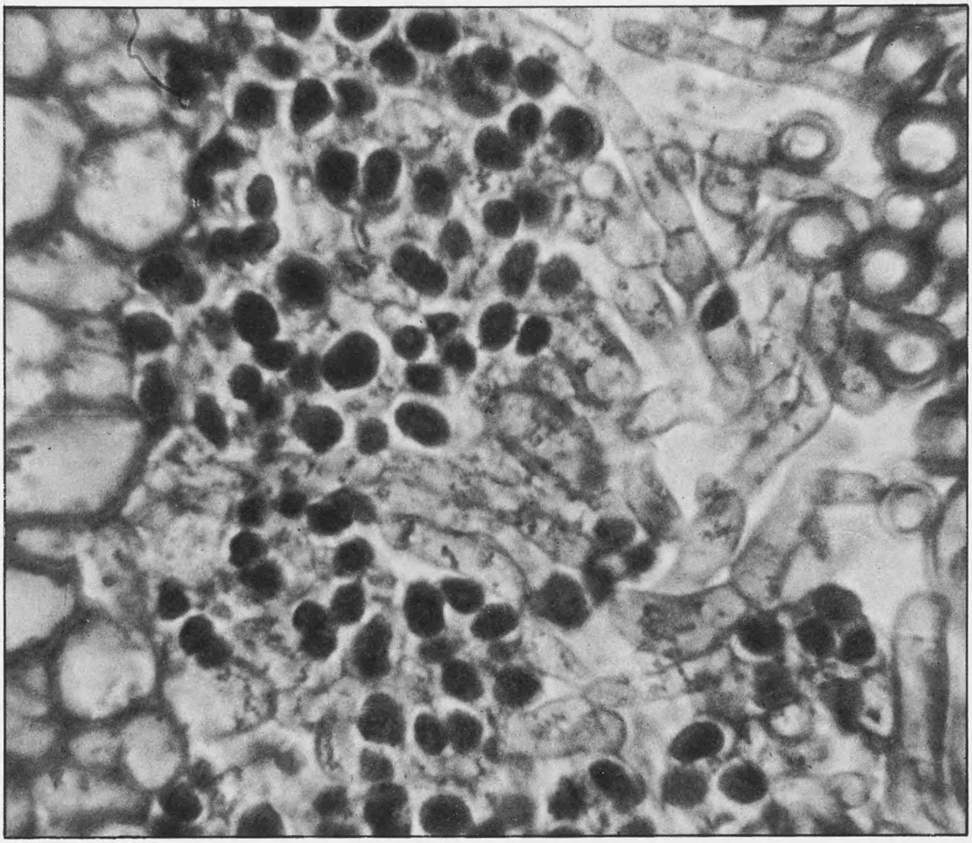
An indicator dye in chemistry is one where the color appears only under certain conditions, and a widely used one is litmus (paper) — a coarse way of telling whether something is acidic or basic. This used to be simply a lichen extract spread on paper strips. It turns blue for alkalis and pink for acids, and is a most convenient chemical identifier, although it does not have the precision of some other indicators. Currently "litmus" — as well as numerous other chemical products — is a synthetic no longer obtained from a lichen.

Although it would be an oversimplification to say that the basis for animal life in the arctic tundra rests on lichens, it's true that lichens somewhat approximate the role of grass in more temperate ecosystems. Other plants are not really lacking in such tundra locations as Churchill, but lichens are so highly developed in these areas. The probable explanation for the great development of lichens is a combination of weather and physical conditions in the arctic and of qualities of the plant itself. Most lichens never really do die in response to long periods of drought and/or cold; but are able to go into a dormancy which is easily revived with warmth and moisture. The shallow snow cover in the tundra can become an effective greenhouse as the spring days lengthen and lichen growth conditions are really excellent under the snow. Then the long summer days provide much sunshine which somewhat compensates for winter dormancy. Even the most prolific plants couldn't make a success

being continually grazed, so it follows that one factor in the lushness of the arctic lichen flora is that the effect of herbivorous animals is not too oppressive. Enormous herds of caribou eat lichens as an important part of their diet, but their migratory habits make possible the recovery of lichen areas after grazing. When the herd returns to a given area a dozen or so years later, the lichen flora has had a chance to regrow.

Lichen growth is not very impressive, compared to that most of the flowering plants. Arctic growth conditions tend to be somewhat more equal for all plants, there, but even so, some valuable ideas of the slowness of lichen growth can be gathered from local conditions. Some special requirements are necessary because of the slow growth; the substrate on which they're found should be quite stable and unchanging, and the time when they begin to grow should be known. A rock surface in nature is suitably stable, but cannot be accurately dated, so lichenologists have often turned to buildings, tombstones, walls, bridges, whose beginnings are known. Then the lichens there now show the rate at which these surfaces have been

Earlham, November 1959



colonized. In nature, stable surfaces usually acquire lichens which in turn contribute to the "decay" processes which are so predictable a part of the evolution of the earth's crust. Of course, there is physical degradation of exposed rock as waves crash, water borne sediment chips away, glaciers grind, temperature changes crack and chemical combinations occur with various exposed minerals. But plant life is also at work performing its life functions, some side effects of which contribute to the reducing of rock to sand which when incorporated with plant remains becomes the soil. Basically the same process of breakdown of rocks to rock dust follows from the action of plants as it does from physical forces. Small pits and cracks in the rock caused by chemical reactions in water and/or air as well as the secretion of acids from plant rootlets fill with water which freezes to open the cracks. Flakes of rock are lifted from boulders when the outside surfaces compress as they cool quicker than the still expanded inner surfaces after a day of the sun's insolation. In sum total though, the enormity of the soil supply on earth today is eloquent testimony to the effectiveness of all of the forces contributing to break down solid rock, and one of the significant bio-erosive forces is lichen action.

Just as the presence of certain plants can indicate some sub-surface characteristic (e.g., willows and much ground water), similarly lichens may be considered to indicate some conditions of their environment. Probably the most striking is the absence of lichens when the air is heavily polluted, especially with sulphur. This condition is to be found where soft coal is extensively used, and the effect even shows up as influenced by winds: normal lichen populations upwind of a city contrasted with a poor lichen flora downwind. Other air pollutants must have some deleterious effects also, because some southerly cities also show poor lichen growths in their environs. There's some likelihood that the assay of certain kinds of lichens could be used as a prospecting technique, because these species have a tendency to accumulate this or that kind of mineral which may be in the soil. An unfortunate aspect of this is their tendency to take in the metals (especially strontium) which contain radioactivity by nuclear test's windborne fallout to the arctic and thus causing a concentration of the radioactivity into the flesh of grazing caribou. The caribou in turn is one of the principal game animals of the Eskimos and Icelanders, and in consequence of eating "hot" caribou meat these people have acquired body radioactivity that is as high as 1/3 of the maximum permissible limit. They may now serve as a living laboratory of the effects of having radioactivity in their daily lives from now on. This lichen to caribou to man food chain, wherein cumulative chemicals are increasingly concentrated at each step of the chain is so obvious that one wonders how its importance could have been overlooked for so many years. It's due to this concentrating process that pesticides, lead, mercury, fallout, all "come home to roost" with the creatures at the top of the food chain.

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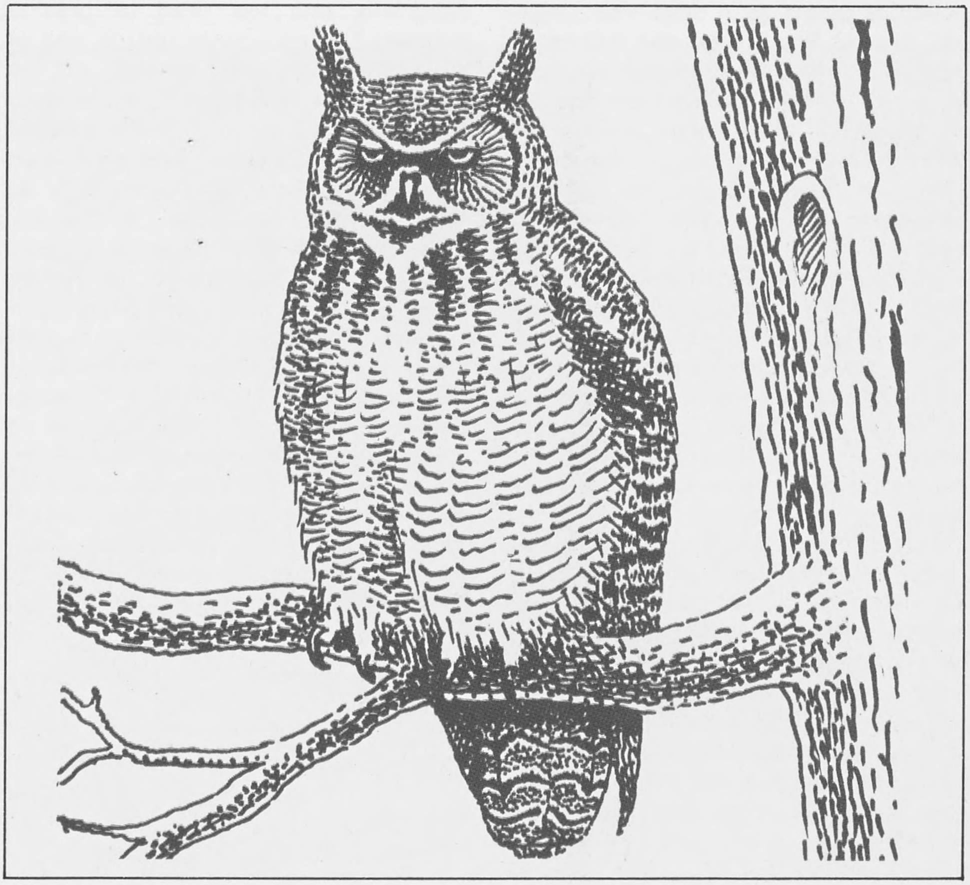
. . . that stirring within

HAROLD MOSSOP

Great Horned Owl

Harold Mossop



The sound came from a heavily treed section along the banks of the Seine River in St. Vital. It was the night of Feb. 22, not yet officially spring by the calendar but the Great Horned Owl already felt the return of the annual cycle. Despite snow, ice and temperature there came that stirring within — call it hormone stimulation if you will — which caused Old Hooter to give voice. This he did with a vigour and sound full of meaning to the ears for which it was intended.

Again and again the resonant booming resounded through the trees with a regularity that had just one interpretation; it was a portent of things to come, of spring, mating and migration; the most thrilling time of the year for the student of ornithology.

A hundred, a thousand to almost seven thousand miles south of our latitude; within the Horned Larks in the Dakotas, the Robins in Kentucky, the House Wrens in Mexico, the Chimney Swifts in Peru, the Golden Plovers on the pampas of Argentina or the Knots as far away as Patagonia; the great stimulus is at work. There is a restlessness, an urge among the feathered legions drawing them northward. With each call of the northern owl a million pairs of wings respond in distant lands. The owners of these wings will come to us, mysteriously, inexorably drawn by cords invisible to the land of their birth. Many will perish in the long journey, for the hazards are great but they will come. We will again welcome the sight and sound of the first Crow of spring, the flute of Meadowlark and clangour of wild geese.

An amazing feature of bird migration is regularity. We can be sure that a certain species will arrive in spring within a certain few days that have been predestined for centuries. If the first Crows are not reported in the Winnipeg area by March 15 to 18, they have been hindered by adverse weather; they'll get through, though, by the 23rd at the latest. So it is with Canada Geese, a few advance scouts by March 18 (the late Alf Hole's earliest date at his Rennie sanctuary), a few small, scattered flocks by the 25th; by April 3rd they will be here.

To the prairie farmer the song of the Western Meadowlark perhaps equals the honk of geese as his greatest spring thrill. By March 26 or 27, this clear carol will first be heard. By April 5, most prairie dwellers will know that the larks (Meadowlarks are not larks but one of the Icterids, or American Starlings) are back.

Fifty years ago the Eastern Bluebird was often referred to as our

true harbinger of spring. But for various reasons this beautiful creature all but disappeared from the Manitoba scene. It is now re-establishing itself. Credit for this is due largely to the placing in suitable habitat of thousands of bird houses to compensate for loss of natural nesting cavities. The first "Bluebird Lane" was begun several years ago in the environs of Brandon, Man., by John Lane and his Brandon Junior Birders Club. A similar project is now under way by several boys of our Natural History Society in Winnipeg. We may again have the thrill of seeing both bluebird species, Eastern and Mountain, during the last three days of March or the first week of April.

The first spring arrival on most annual migration records kept is usually the Horned Lark. This is Canada's only true native lark. By now their tinkling songs may be heard on southern Manitoba prairies. They may be seen here anywhere from Feb. 5 to 20. True, they didn't have far to come, just from the Dakotas and Minnesota. More have now arrived from Nebraska and have "leap-frogged" over the first arrivals. Others, the far northern nesters, will soon pass through on their way to Arctic tundras. As they do, our southern Manitoba larks will have begun nesting.

Lapland Longspurs, Rusty and Red-winged Blackbirds, Rough-legged and Red-tailed Hawks and Killdeers will all arrive by April 1 or within a week thereafter, soon to be followed by Mallards and Pintails. Then come the Song, Tree and Swamp Sparrows and Hermit and Swainson's Thrushes, April 5 to 15.

Then the great rush is on, each day bringing fresh arrivals, each in its appointed time, that is, within a week or at most ten days as storm and other weather conditions permit. It must be remembered too, that most of our small birds; wrens, vireos, warblers, thrushes, etc., migrate at night which all adds to the mystery of their coming.

The great phenomenon then rapidly draws to a close during the last few days of May when Eastern and Western Wood Pewees and Black-billed Cuckoos are expected, though these may not turn up until June 4th or 5th.

The question that looms in the mind of every bird student is the "how" and "why" of bird migration. How do birds know when to go, in what direction to go, how far to go? How can they possibly find their way to a predetermined destination at night?

Stories of old and experienced birds leading the young over invisible aerial paths make pleasant reading but apart from small limitations are pure bunkum. Many adults leave on a 5000 mile journey without their young, but those that have never migrated before find their way in spite of it.

Birds have remarkable memories for topographical features. Even the tiny wren recognizes your garden and the bird house of last year. But this does not explain how it flew miles in darkness and surprised you with its early morning song; that same wren that nested in your garden last summer. How did it know when it had reached its destination?

Many are the theories that are backed by convincing experiments. These include memory for landmarks, celestial navigation, in-born instinct.

By late May, when shorebirds that have wintered far away are passing through on their way to the Arctic, the owl that now announces their coming will have almost completed nesting.

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